CLAIMS

What is claimed is:

1. A method for providing a sensor network comprising:

coupling a plurality of network elements including a plurality of node types among at least one environment and at least one user, wherein the plurality of node types includes at least one node of a first type and at least one node of a second type;

remotely controlling at least one function of the plurality of node types;

collecting data from the at least one environment;

providing node resource information from the at least one node of a second type to the plurality of network elements; and

distributing storage and processing of the collected data among the plurality of network elements in response to the node information.

2. The method of claim 1, further comprising performing a first type of data manipulation by the at least one node of a first type and performing a second type of data manipulation by the at least one node of a second type.

3. The method of claim 1, further comprising automatically organizing the plurality of network elements in response to the node information, wherein the automatic organizing comprises automatically controlling data transfer, processing, and storage among the plurality of network elements.

4. The method of claim 1, further comprising supporting a plurality of levels of synchronization among different subsets of the plurality of network elements, wherein a first level of synchronization is supported among a first subset of the plurality of network elements, wherein a second level of synchronization is supported among a second subset of the plurality of network elements.

5. The method of claim 1, further comprising controlling data processing using at least one processing hierarchy, the at least one processing hierarchy

3   controlling at least one event selected from a group consisting of data

4   classifications, data transfers, data queuing, data combining, processing

5   locations, and communications among the plurality of network elements.

1   6.   The method of claim 1, further comprising self-assembling the plurality

2   of network elements, wherein search and acquisition modes of the at least one

3   node of a second type search for participating ones of the plurality of network

4   elements, wherein a determination is made whether each of the participating

5   ones of the plurality of network elements are permitted to join the sensor

6   network using a message hierarchy, wherein the sensor network is surveyed at

7   intervals for new nodes and missing nodes.

1   7.   The method of claim 1, further comprising managing the plurality of

2   network elements as a distributed and active database using a distributed

3   resource management protocol, wherein the plurality of network elements are

4   reused among different applications, wherein the network elements are used in

5   multiple classes of applications.

1   8.   The method of claim 1, wherein the at least one function includes data

2   acquisition, data processing, communication, data routing, data security,

3   programming, and node operation.

1   9.   The method of claim 1, wherein the at least one node of a first type

2   includes at least one preprocessor coupled among at least one state machine, at

3   least one application programming interface (API), and at least one sensor.

1   10.   The method of claim 1, wherein the at least one node of a second type

2   includes at least one preprocessor coupled to at least one processor and a

3   plurality of application programming interfaces (APIs), wherein the plurality of

4   APIs are coupled to control at least one device selected from a group consisting

5   of sensors, actuators, communications devices, signal processors, information

6   storage devices, node controllers, and power supply devices, wherein the

7   plurality of APIs are support remote reprogramming and control of the at least
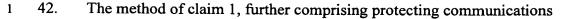
8   one device.

1   11.   The method of claim 10, further comprising layering the plurality of
2   APIs.

1   12.   The method of claim 10, further comprising:
2   enabling distributed resource management with the plurality of APIs by
3   providing network resource information and message priority information to the
4   plurality of network elements; and
5   controlling information transfer among the plurality of network elements
6   using a synchronism hierarchy established in response to the resource
7   information and message priority information.

1   13.   The method of claim 10, wherein the at least one preprocessor performs
2   at least one function selected from a group consisting of data acquisition, alert
3   functions, and controlling at least one operating state of the at least one node,
4   wherein the at least one processor performs at least one function selected from a
5   group consisting of signal identification, database management, adaptation,
6   reconfiguration, and security.

1   14.   The method of claim 1, further comprising controlling data processing,
2   transmission, and storage among the plurality of network elements in response
3   to a decision probability of a detected event.

1   15.   The method of claim 1, further comprising performing at least one
2   operation on the collected data in response to parameters established by a user,
3   the at least one operation selected from a group consisting of energy detection,
4   routing, processing, storing, and fusing.

1   16.   The method of claim 15, wherein the routing, processing, storing, and
2   fusing are performed in response to at least one result of the energy detection.

1   17.   The method of claim 15, wherein routing comprises selecting at least
2   one data type for routing, selecting at least one of the plurality of network
3   elements to which to route the selected data, selecting at least one route to the

4   selected at least one of the plurality of network elements, and routing the

5   selected at least one data type to the selected at least one of the plurality of

6   network elements.

1   18.   The method of claim 15, wherein processing comprises selecting at least

2   one data type for processing, selecting at least one processing type, selecting at

3   least one of the plurality of network elements to perform the selected at least

4   one processing type, and transferring the selected at least one data type to the

5   selected at least one of the plurality of network elements using at least one route

6   through the sensor network.

1   19.   The method of claim 18, wherein the selection of at least one processing

2   type comprises determining at least one probability associated with a detected

3   event and selecting at least one processing type in response to the at least one

4   probability.

1   20.   The method of claim 18, further comprising aggregating data processed

2   in a plurality of nodes for further processing by other nodes.

1   21.   The method of claim 18, further comprising aggregating data processed

2   by the at least one node for reporting to the at least one user.

1   22.   The method of claim 15, wherein storing comprises selecting at least one

2   data type for storage, selecting at least one storage type, selecting at least one of

3   the plurality of network elements to perform the selected at least one storage

4   type, and transferring the selected at least one data type to the selected at least

5   one of the plurality of network elements using at least one route through the

6   sensor network.

1   23.   The method of claim 15, wherein fusing comprises a first node

2   transmitting at least one query request to at least one other node, wherein the

3   first node collects data from the at least one other node in response to the at

4   least one query request and processes the collected data.

1   24.   The method of claim 1, further comprising supporting at least one

2   communication mode among the plurality of network elements, wherein the at

3   least one communication mode is selected from a group consisting of wireless

4   communications, wired communications, and hybrid wired and wireless

5   communications.

1   25.   The method of claim 1, further comprising coupling the at least one

2   node of a first type and the at least one node of a second type to the at least one

3   client computer using at least one of the plurality of network elements, wherein

4   the plurality of network elements includes at least one gateway, at least one

5   server, and at least one network, wherein the at least one network includes

6   wired networks, wireless networks, and hybrid wired and wireless networks.

1   26.   The method of claim 25, wherein the at least one network comprises at

2   least one network selected from a group comprising the Internet, local area

3   networks, wide area networks, metropolitan area networks, and information

4   service stations.

1   27.   The method of claim 26, further comprising internetworking among the

2   plurality of network elements to provide remote accessibility using World Wide

3   Web-based tools to data, code, management, and security functions, wherein

4   data includes signals, wherein code includes signal processing, decision support,

5   and database elements, and wherein management includes operation of the at

6   least one node and the sensor network.

1   28.   The method of claim 25, wherein the at least one gateway performs at

2   least one function selected from a group consisting of protocol translation,

3   management of the plurality of network elements, management of

4   communications with at least one remote user, management of communications

5   with at least one local user, and interfacing with at least one communication

6   physical layer including wired local area networks, packet radio, microwave,

7   optical, wireline telephony, cellular telephony, and satellite telephony.

29.   The method of claim 1, wherein the plurality of network elements further comprise at least one database, wherein the at least one database includes at least one storage device selected from a group consisting of storage devices coupled to at least one of the plurality of network elements and storage devices separate from the plurality of network elements.

30.   The method of claim 29, further comprising providing non-local event correlation using cooperative sensing with information of the at least one database.

31.   The method of claim 29, wherein the at least one database comprises data-driven alerting methods that recognize conditions on user-defined data relationships including coincidence in signal arrival, node power status, and network communication status.

32.   The method of claim 29, further comprising implementing the at least one database in small foot print databases at a level of the at least one node of a second type and in standard query language (SQL) database systems at a level of at least one server.

33.   The method of claim 1, wherein the at least one node of a second type includes sensing, processing, communications, and storage devices supporting a plurality of processing and protocol layers.

34.   The method of claim 1, further comprising establishing at least one redundant information pathway among the plurality of network elements.

35.   The method of claim 1, wherein the plurality of network elements comprise a plurality of network element sets, wherein the plurality of network element sets are layered.

36.   The method of claim 1, wherein the at least one node comprises a plurality of node types, wherein the plurality of node types includes at least one node of a first type and at least one node of a second type, wherein a first

4   network having a first node density is assembled using the at least one node of a

5   first type, wherein a second network having a second node density is assembled

6   using the at least one node of a second type, wherein the second network is

7   overlayed onto the first network.

1   37.   The method of claim 1, further comprising predistributing code and data

2   anticipated for future use through the sensor network using low priority

3   messages, wherein the code and the data are downloadable from at least one

4   location selected from a group consisting of storage devices of the plurality of

5   network elements, and storage devices outside the sensor network.

1   38.   The method of claim 1, further comprising transferring data using

2   message packets, wherein the message packets are aggregated into compact

3   forms in the at least one node using message aggregation protocols, wherein the

4   message aggregation protocols are adaptive to at least one feature selected from

5   a group consisting of data type, node density, message priority, and available

6   energy, wherein the message packets include decoy message packets, wherein

7   information to be transferred is impressed on random message packets to

8   provide communication privacy.

1   39.   The method of claim 1, wherein the at least one node of a first type and

2   the at least one node of a second type include at least one sensor selected from a

3   group consisting of seismic, acoustic, infrared, thermal, force, vibration,

4   pressure, humidity, current, voltage, magnetic, biological, chemical,

5   acceleration, and visible light sensors.

1   40.   The method of claim 1, wherein at least one of the plurality of network

2   elements determines a position of at least one other of the plurality of network

3   elements.

1   41.   The method of claim 1, further comprising transferring software among

2   the plurality of network elements, wherein the software transfer is remotely

3   controllable.

1   42.   The method of claim 1, further comprising protecting communications
2   among the plurality of network elements using at least one public key security
3   protocol.

1   43.   The method of claim 1, further comprising determining at least one
2   location of at least one of the plurality of network elements using location and
3   time information of at least one Global Positioning System (GPS) device.

1   44.   The method of claim 1, wherein the plurality of node types comprise at
2   least one node type selected from a group consisting of sensor nodes, gateway
3   nodes, thin film substrate sensor nodes, taag nodes, conformal nodes, wired
4   nodes, wireless nodes, personnel nodes, equipment nodes, and vehicle
5   internetwork nodes.

1   45.   The method of claim 1, further comprising supporting short range and
2   long range communications among the plurality of network elements.

1   46.   A method of operating a sensor network, comprising:
2   coupling a plurality of network elements including a plurality of node
3   types among at least one environment and at least one user computer with at
4   least one Internet coupling;
5   collecting data from the at least one environment using at least one node
6   of a first type; and
7   remotely programming and controlling at least one function of the
8   plurality of node types in response to the collected data via internetworking
9   among the plurality of network elements.

1   47.   The method of claim 46, further comprising:
2   providing node information including node resource information and
3   message priority from at least one node of a second type to the plurality of
4   network elements;
5   distributing processing of the collected data to the plurality of network
6   elements in response to the node information.

1 48.   A computer readable medium containing executable instructions which,
2 when executed in a processing system, cause the processing system to collect
3 and process data in a sensor network by:
4   coupling a plurality of network elements including a plurality of node
5 types among at least one environment and at least one user, wherein the
6 plurality of node types includes at least one node of a first type and at least one
7 node of a second type;
8   remotely controlling at least one function of the plurality of node types;
9   collecting data from the at least one environment;
10   providing node resource information from the at least one node of a
11 second type to the plurality of network elements; and
12   distributing storage and processing of the collected data among the
13 plurality of network elements in response to the node information.

1 49.   An electromagnetic medium containing executable instructions which,
2 when executed in a processing system, cause the processing system to collect
3 and process data in a sensor network by:
4   coupling a plurality of network elements including a plurality of node
5 types among at least one environment and at least one user, wherein the
6 plurality of node types includes at least one node of a first type and at least one
7 node of a second type;
8   remotely controlling at least one function of the plurality of node types;
9   collecting data from the at least one environment;
10   providing node resource information from the at least one node of a
11 second type to the plurality of network elements; and
12   distributing storage and processing of the collected data among the
13 plurality of network elements in response to the node information.

1 50.   A computer readable medium containing executable instructions which,
2 when executed in a processing system, cause the processing system to collect
3 and process data in a sensor network by:

4   coupling a plurality of network elements including a plurality of node

5   types among at least one environment and at least one user computer with at

6   least one Internet coupling;

7   collecting data from the at least one environment using at least one node

8   of a first type; and

9   remotely programming and controlling at least one function of the

10   plurality of node types in response to the collected data via internetworking

11   among the plurality of network elements.

1   51.   An electromagnetic medium containing executable instructions which,

2   when executed in a processing system, cause the processing system to collect

3   and process data in a sensor network by:

4   coupling a plurality of network elements including a plurality of node

5   types among at least one environment and at least one user computer with at

6   least one Internet coupling;

7   collecting data from the at least one environment using at least one node

8   of a first type;

9   providing node information including node resource information and

10   message priority from at least one node of a second type;

11   remotely programming and controlling at least one function of the

12   plurality of node types in response to the collected data and node information

13   via internetworking among the plurality of network elements.